Pixel Variation on LSST CCDs and its 2 point correlation

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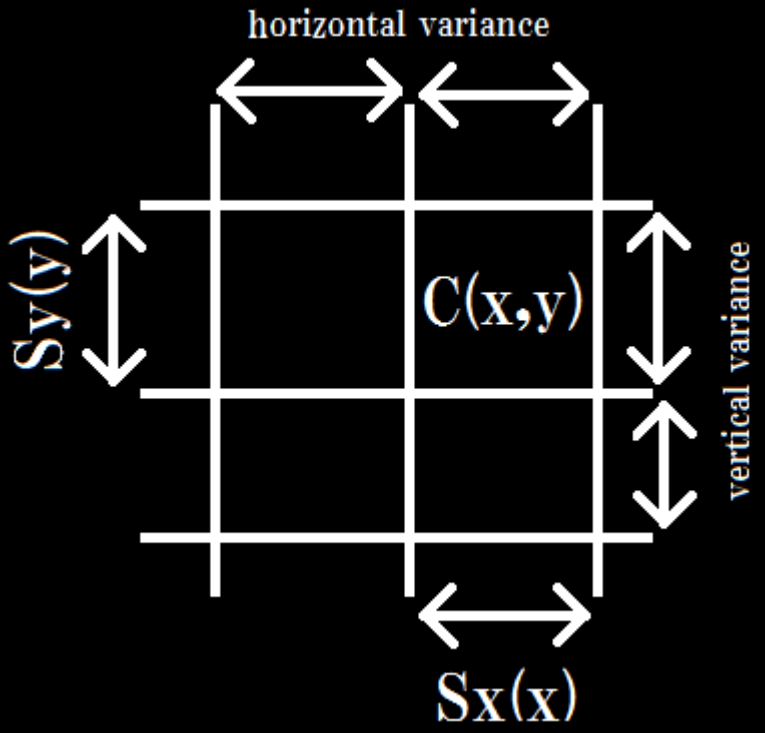
Pixel variance is difference of vertical and horizontal length from assumed pixel size and the differences make spurious convergence and spurious shear.

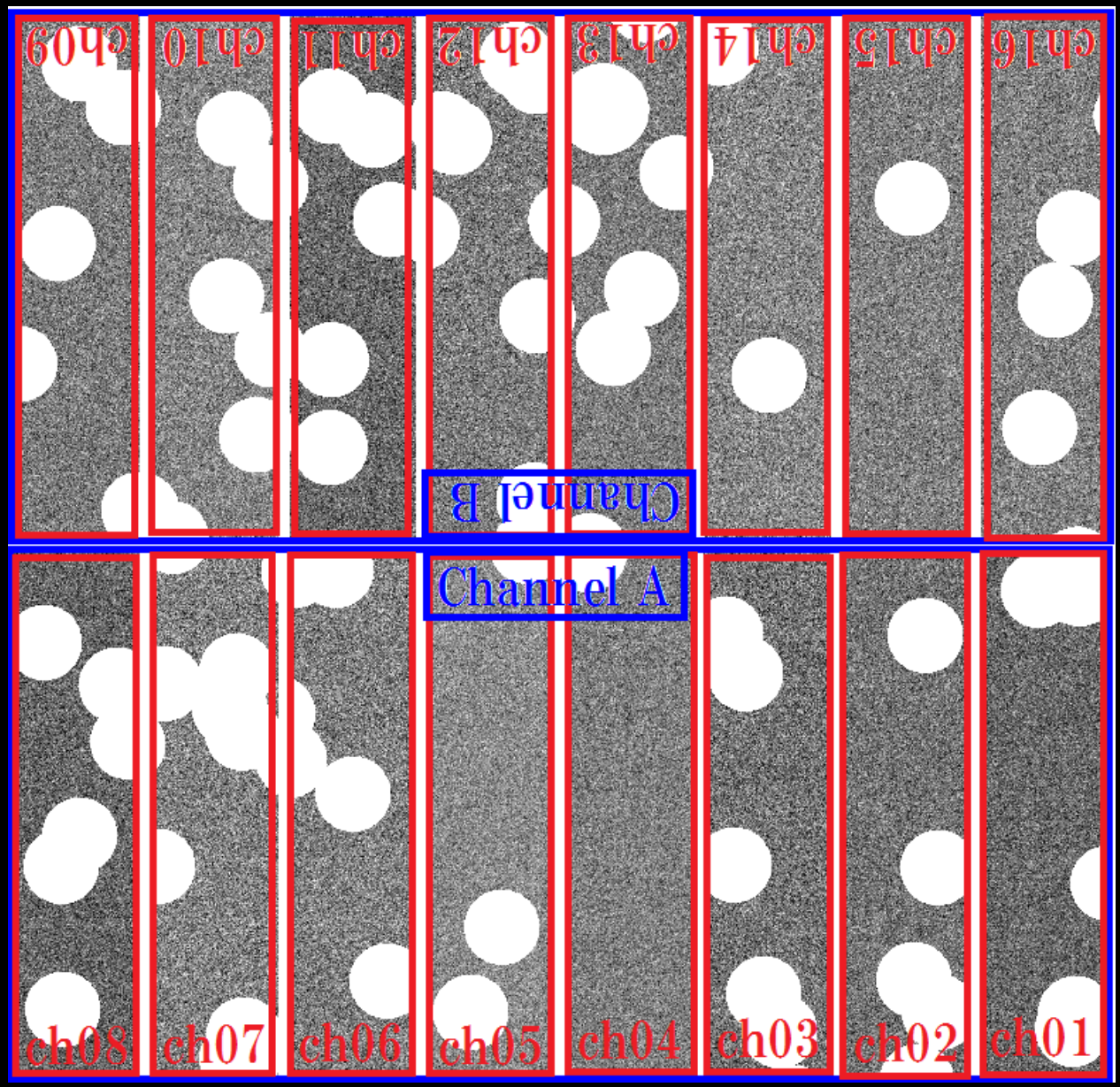


Smoothed image of
LSST CCD flat image

Data

- Stacking e2v 25 shots
  0.4% STD
- Masking
  for edge effects
  for shadow from dusts
- 7th order Polynomial
  for non-flat light source

- labeling channel A
  for bottom 8 channels
- labeling channel B
  for upper 8 channels



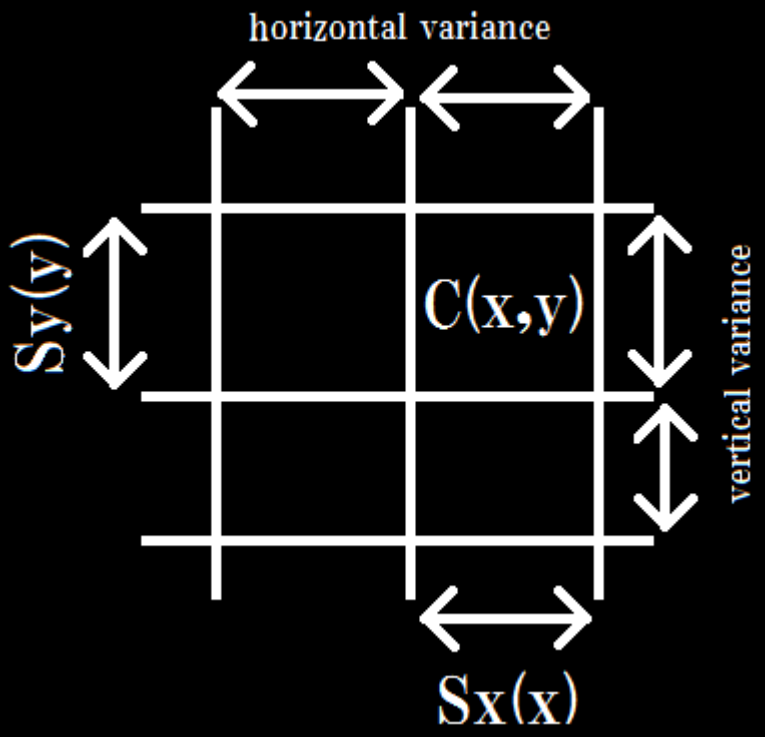
Method : Averaged Count

Method is comparing average count on lines.

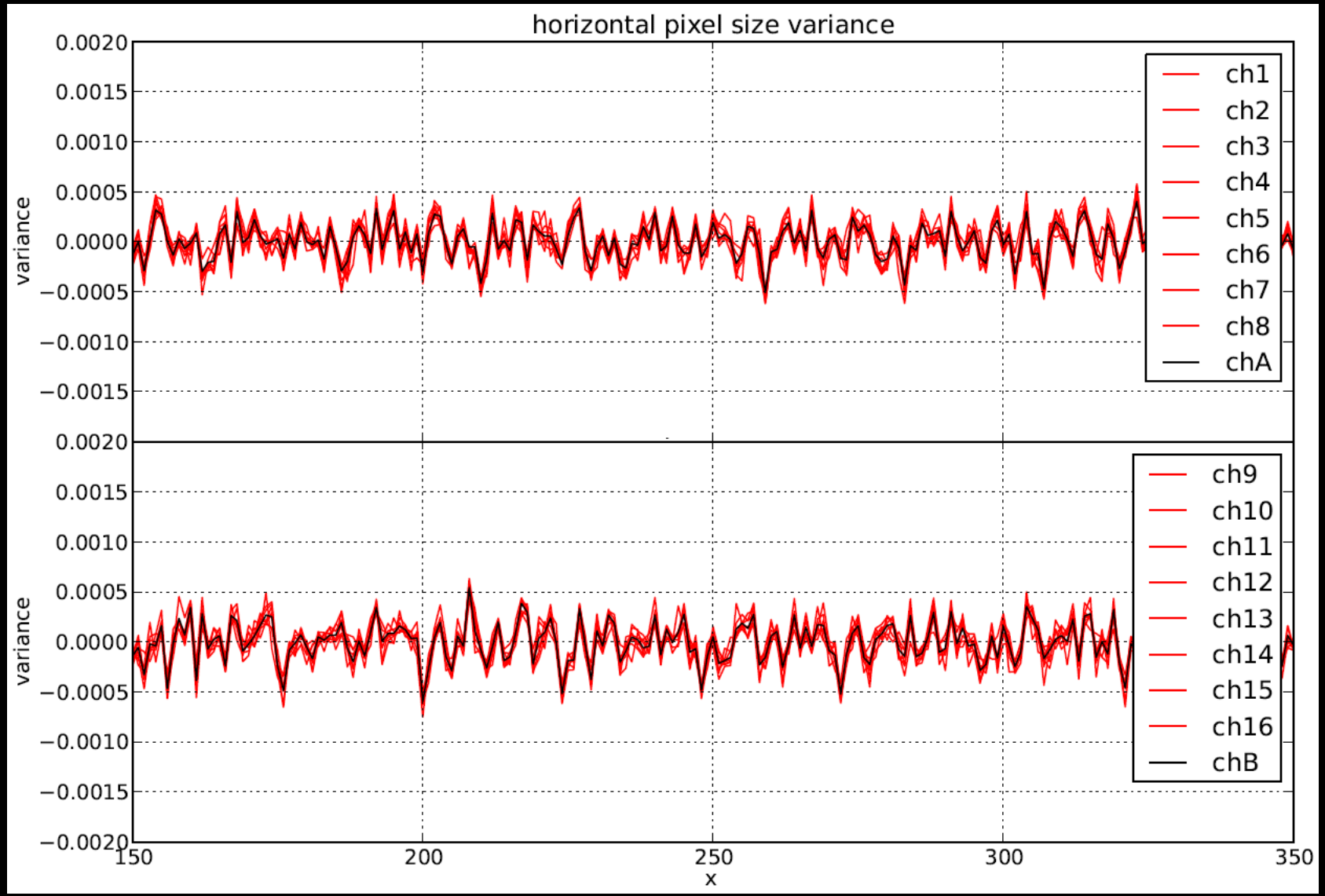
- Assuming differences of averaged count on lines come from only pixel variances.

- Measure only relative differences from fiducial size which is determined as average of “all” pixels for each lines.

- Assuming the fiducial sizes of vertical and horizontal are same.



Pixel Variance : horizontal



Pixel Variance : horizontal

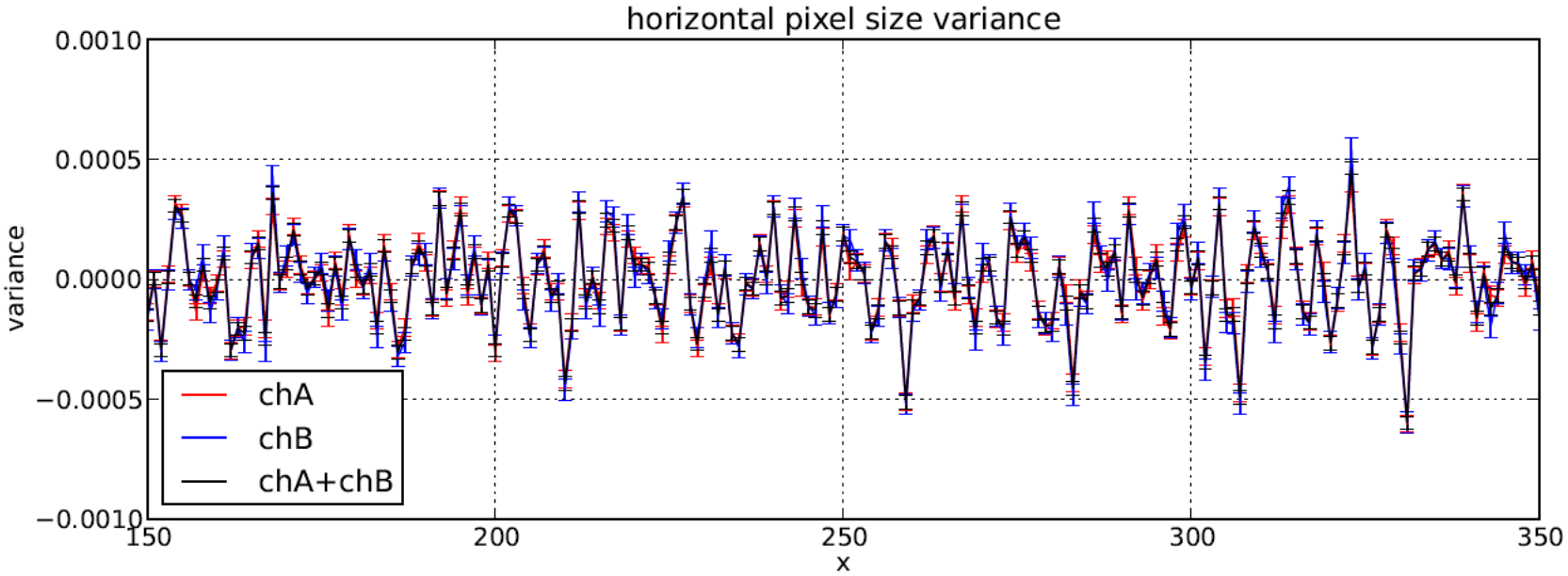


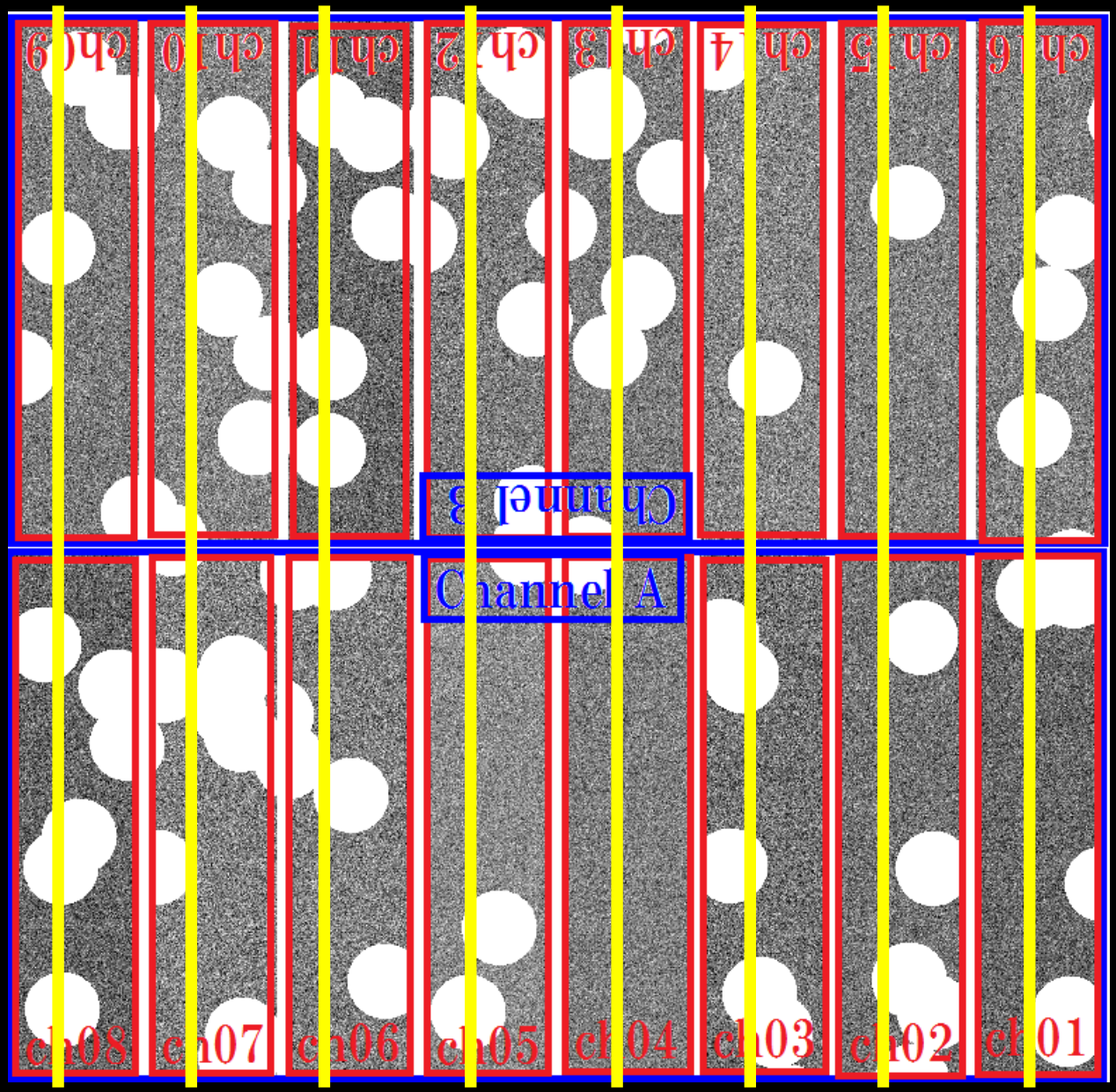
Fig. 13.— red and blue lines mean horizontial pixel variance for channel A and B, but horizontal zxis in channel B is $x' = 531 - x$. Black line means average horizontial pixel variance for all channels.

Pixel Variance : horizontal

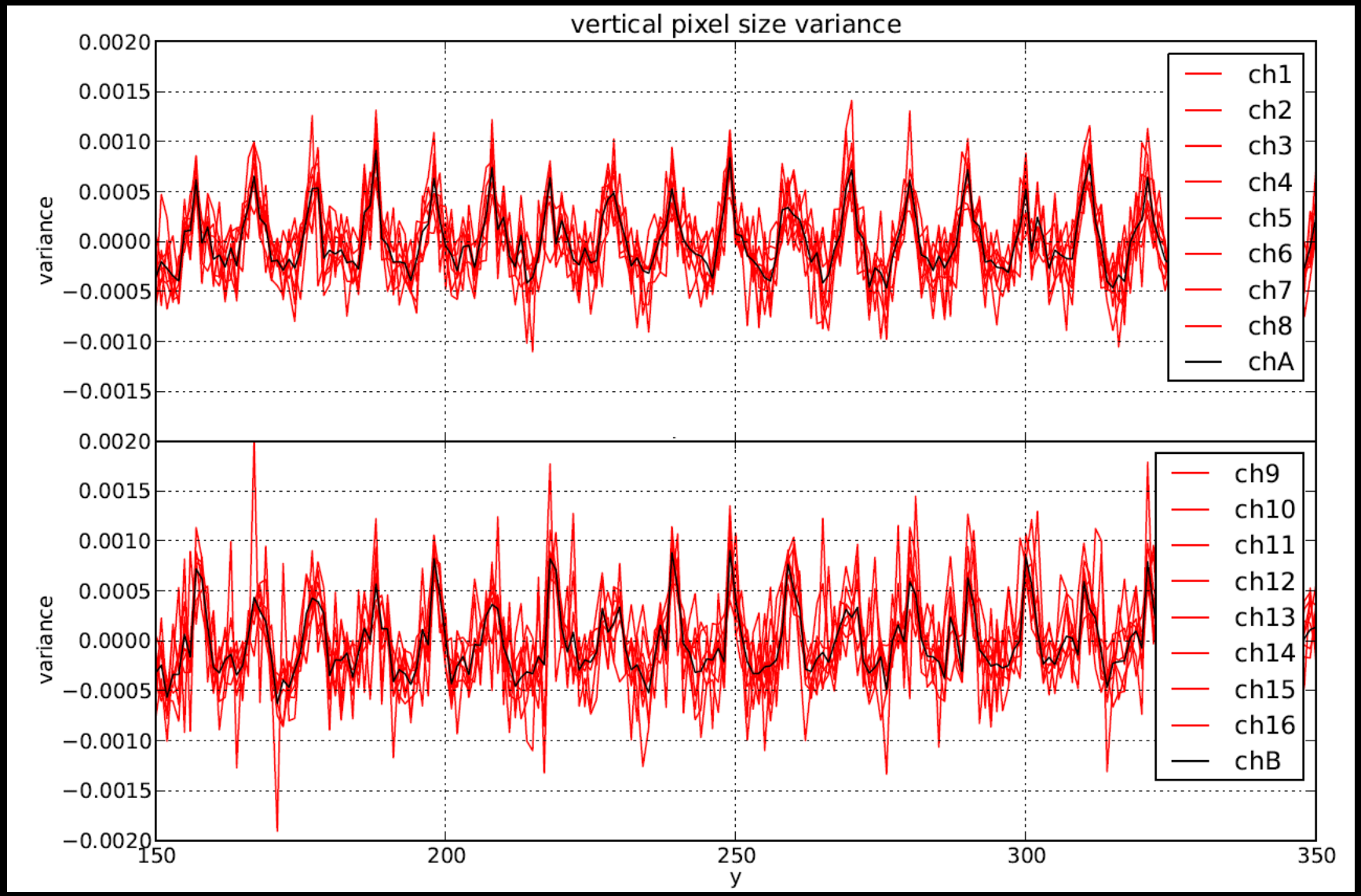
- All pixels in same vertical line have same horizontal length

- All lines which position is same from each basis have same horizontal length.

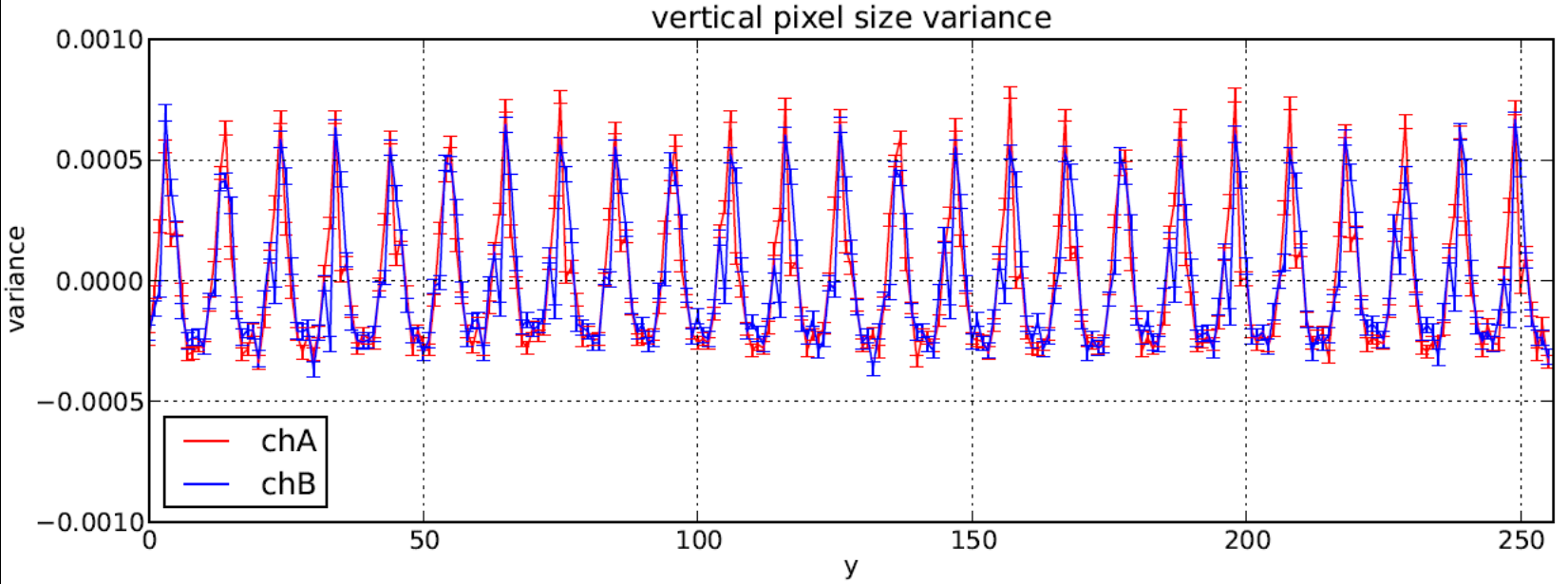
- The variances is about 0.05%



Pixel Variance : vertical



Pixel Variance : vertical 256 pixel pattern



16.— vertical pixel variance for channel A and B in large section.

2048 pixels have 8 same large sections with 256 pixels

Pixel Variance : vertical 41 pixel pattern

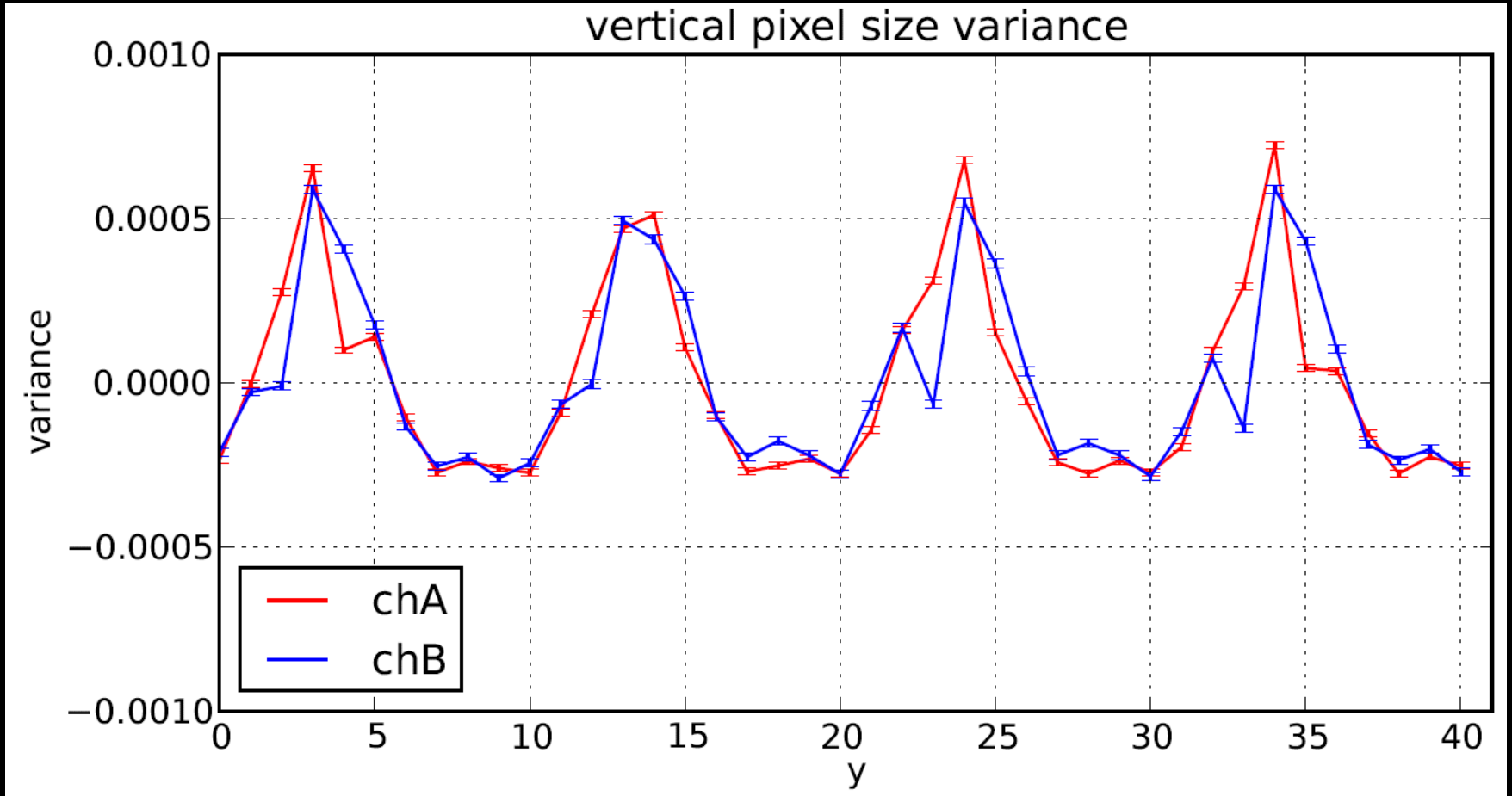
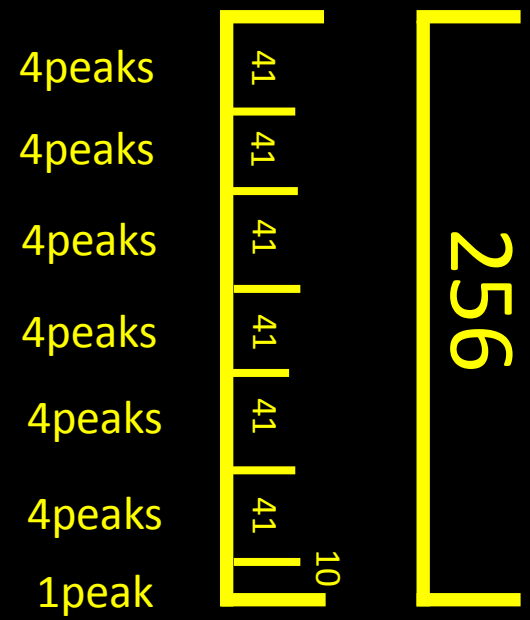


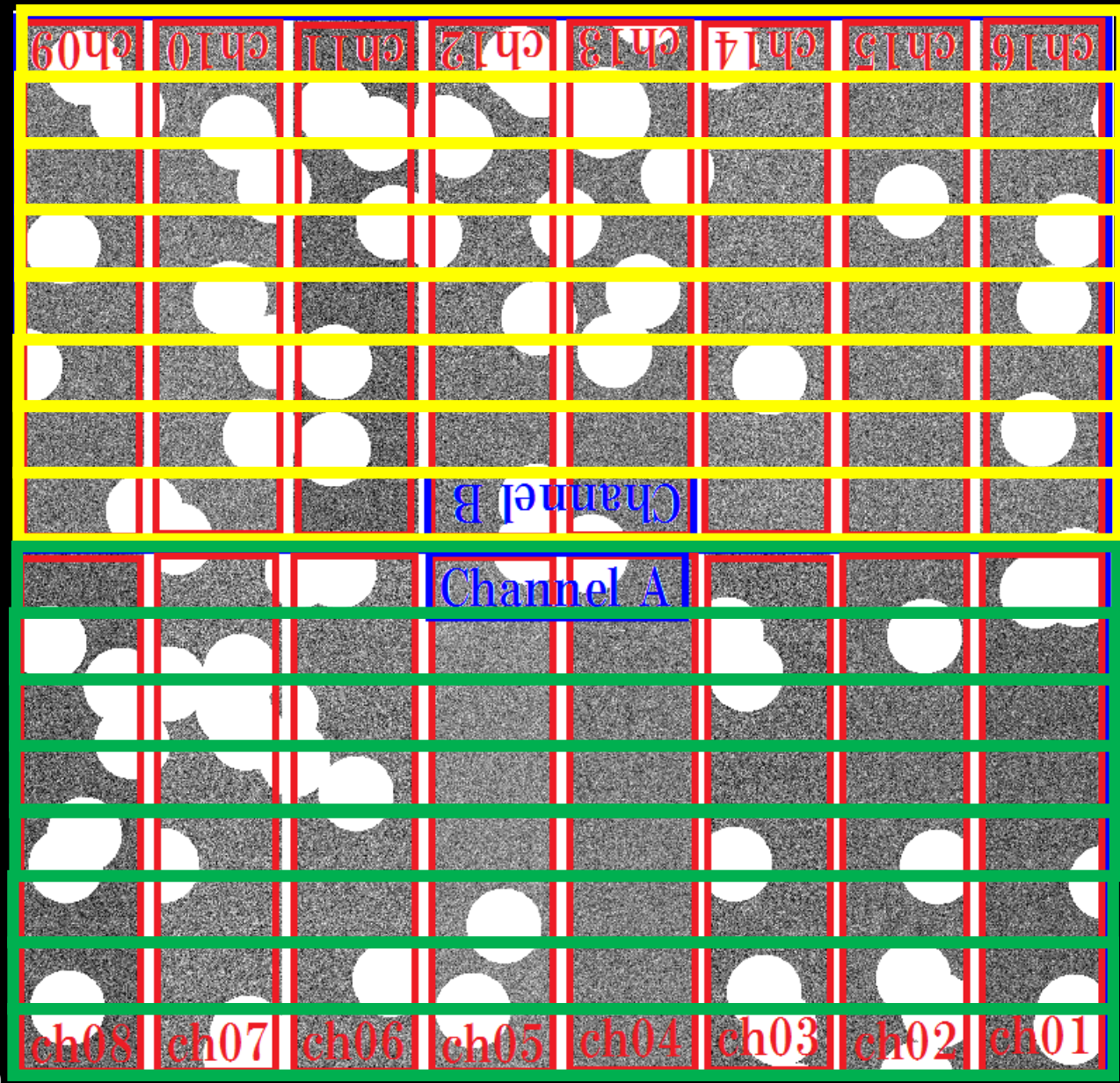
Fig. 17.— vertical pixel variance for channel A and B in small section.

256 pixels have 6 smae small sections with 41 pixels + 1 section with 10 pixel

Pixel Variance : vertical



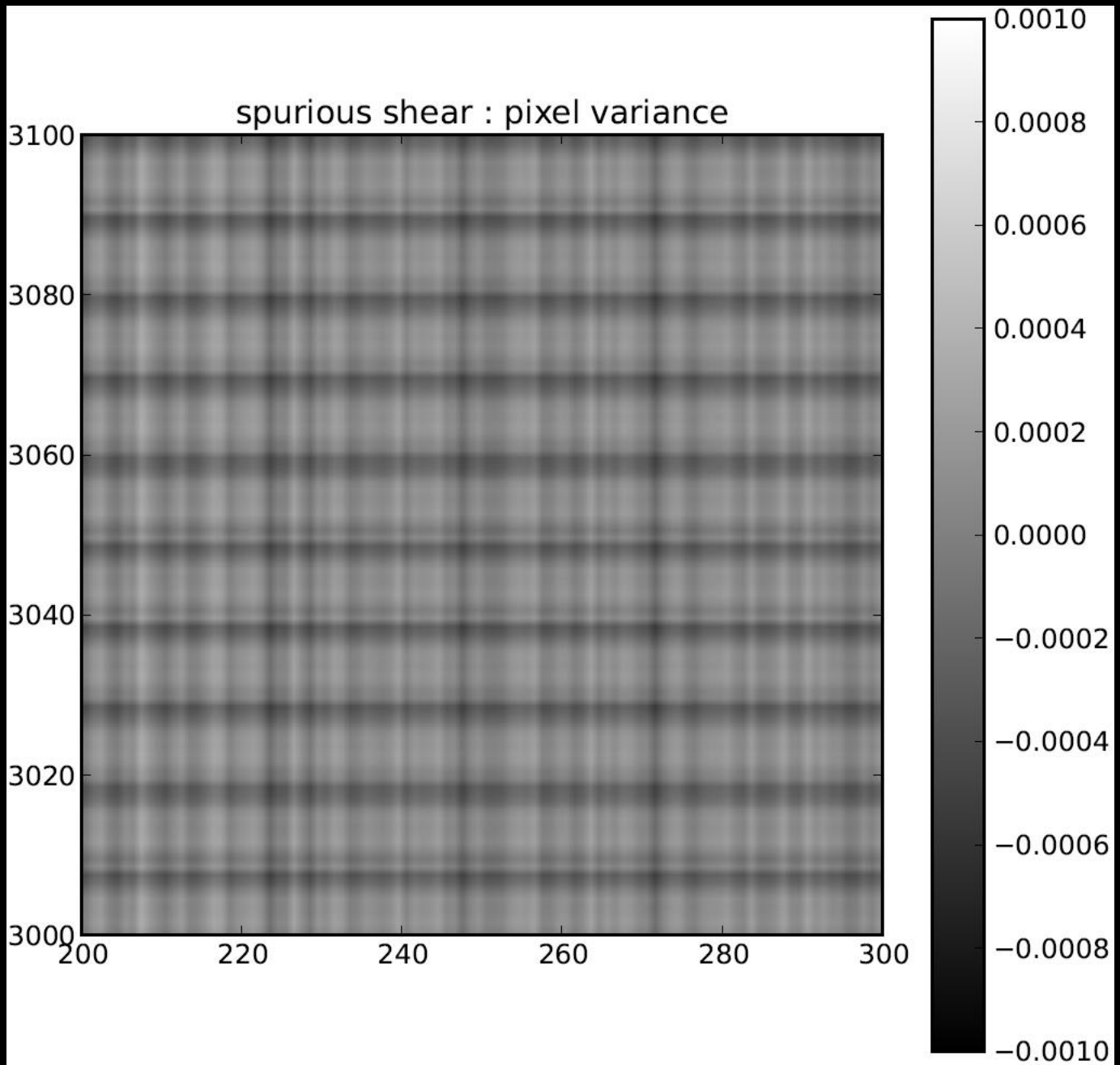
- 1 channel has 8 large section having 256 pixels
- The large section has small section having 41 pixels plus 1 peak (1pixel)
- The small section has 4 peaks
- The variances is about 0.05%



2point correlation : calculated pattern

• The differences of length change size and ellipticity, half of it is spurious convergence and half of it is spurious shear.

• Assuming galaxy size as 5x5 pixels square.
Used 5x5 averaged spurious distortion.



2point correlation : CCD

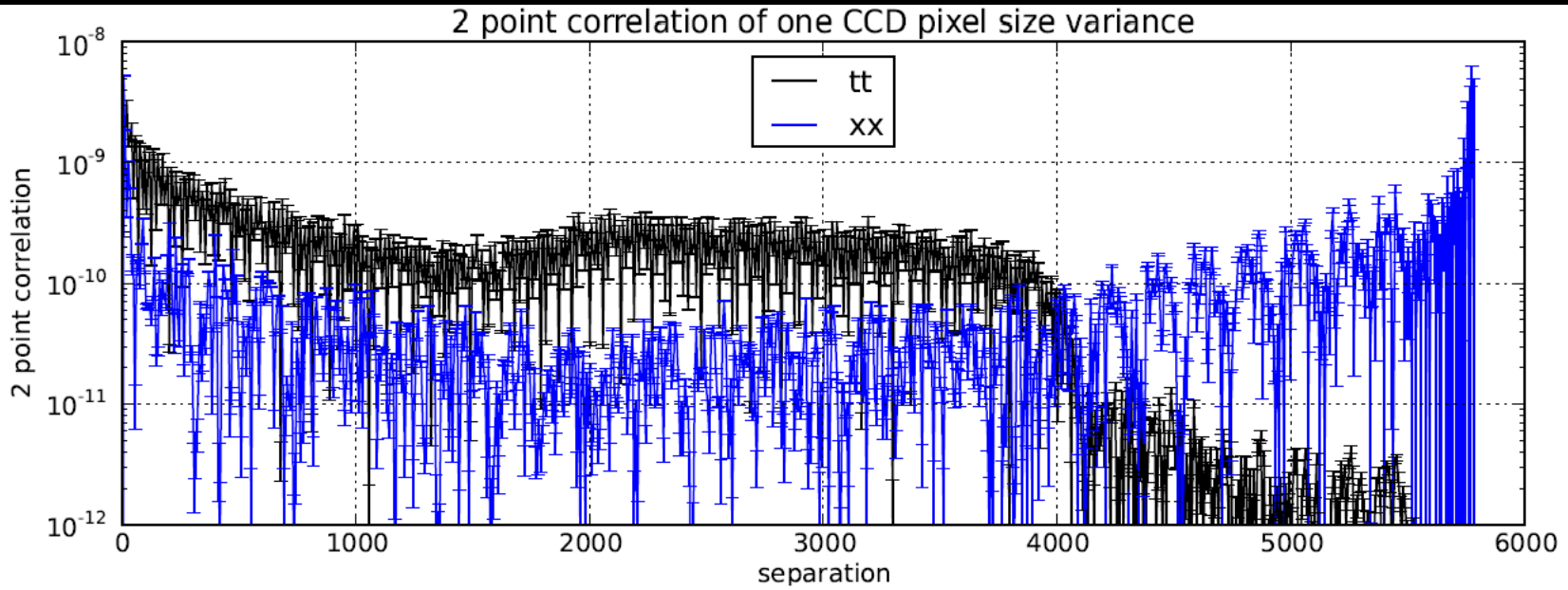


Fig. 18.— Absolute values of the 2-point spurious shear correlations caused by the pixel variation effect on LSST CCD. Black points mean parallel correlation and blue points mean cross correlation with 1000000 random position objects. The values oscillate around zero and we plotted with each 7 pixel scale.

2point correlation : CCD

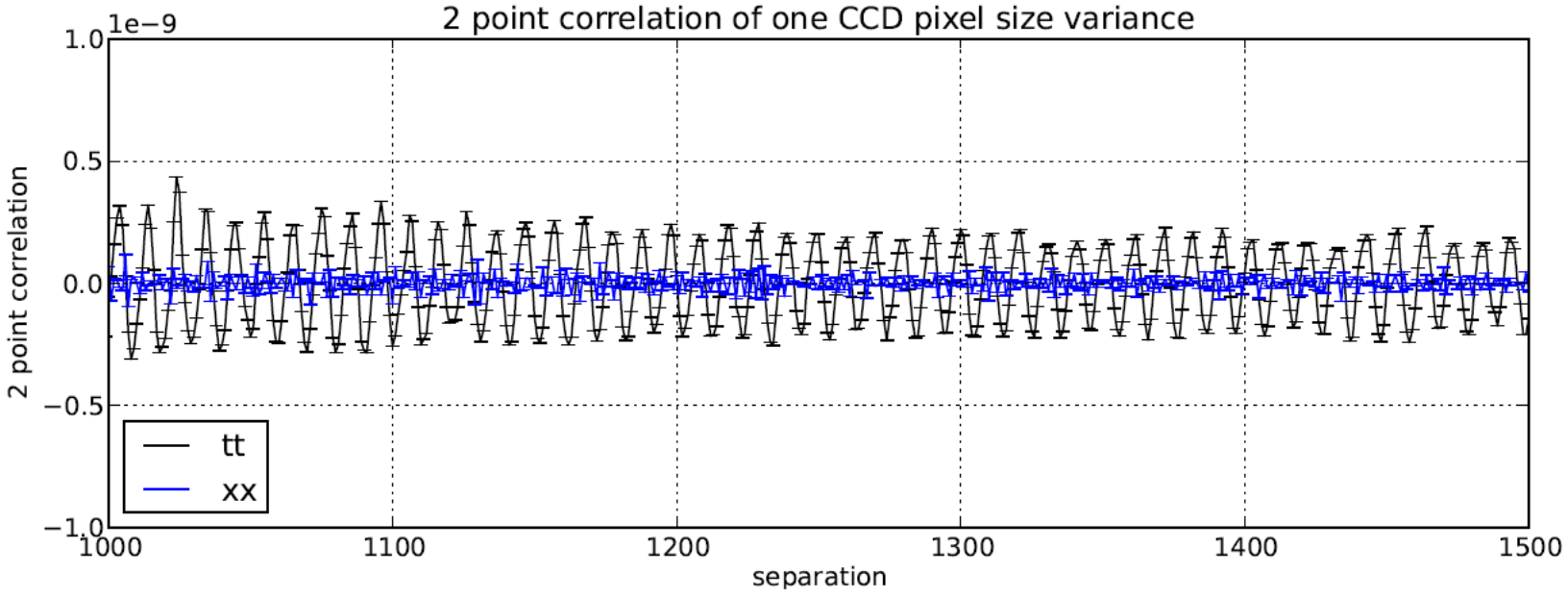


Fig. 19.— Same as figure 18 in selected region, non-absolute value and linear scale for vertical axis.

2point correlation : FOV

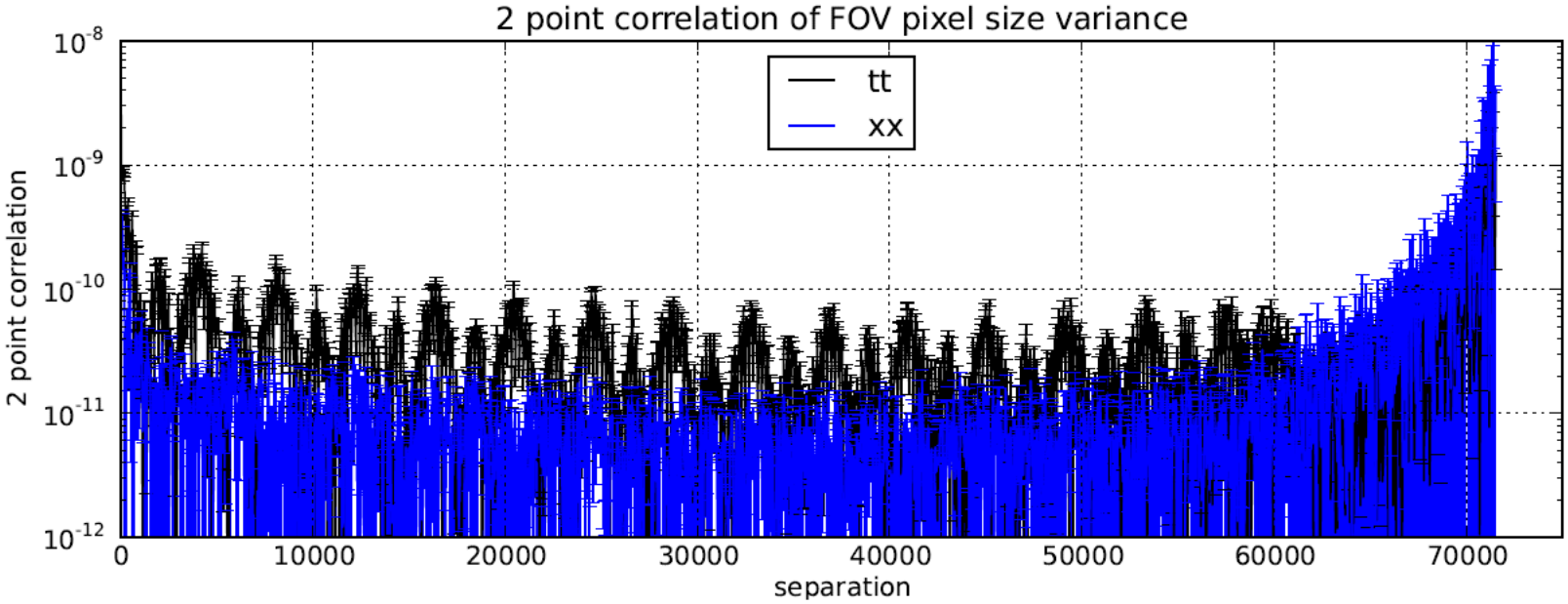


Fig. 20.— Absolute values of the 2-point spurious shear correlations caused by the pixel variation effect on LSST FOV. Black points mean parallel correlation and blue points mean cross correlation with 1000000 random position objects. The values oscillate around zero and we plotted with each 50 pixel scale.

Summary

We measured pixel variances on LSST CCD.

The typical value of the variances are about 0.05%.

All channels have same vertical valiances.

The horizontal variances in chA and chB are different,
but all channels have 8 same large sections with 256pixels,
and the large sections have 6 same small sections with 41 pixels with 4 peaks.
The scale between a peak and next peak is 10pixels or 11 pixels.

2 point correlation function from the pixel variances has correlation with 10pixel scale,
but typical scale of the function is about 10^-10,
so it is very smaller than 2 point correlation function from the cosmic shear.

This measurement method can measure only relative size from fiducial size,
and we determined the fiducial size from average of all pixels
and assumed the fiducial pixel is square.